Check List 9(6): 1391–1395, 2013

ISSN 1809-127X (available at *www.checklist.org.br*)

Check List
Journal of species lists and distribution

LISTS OF SPECIES

Ichthyofauna of two reservoirs in the middle Acaraú river basin, Ceará, Northeastern Brazil

Ronaldo César Gurgel-Lourenço [1*], Wallace Alves de Sousa [2], Jorge Iván Sánchez-Botero [1] and Danielle Sequeira Garcez [2]

1 Universidade Federal do Ceará, Departamento de Biologia. Campus do Pici. Avenida Mister Hull, nº 2977. CEP 60455-760. Fortaleza, CE, Brazil.
2 Universidade Federal do Ceará, Instituto de Ciências do Mar – LABOMAR. Avenida da Abolição, nº 3207. CEP 60165-081. Fortaleza, CE, Brazil.
* Corresponding author. E-mail: *ronaldocgl@yahoo.com.br*

ABSTRACT: Few studies have been published on the taxonomy, biology and ecology of the fish fauna of the rivers and reservoirs from the Brazilian Caatinga. Considering the importance of fish surveys as subsidies for future studies and fishing resources management, the purpose of the present study was to assess the fish assemblage of the two largest reservoirs in the middle Acaraú river basin, the Paulo Sarasate and the Edson Queiroz reservoirs, state of Ceará, Northeastern Brazil. Eight nycthemeral samplings were performed with gillnets (mesh size ranging from 3 to 12 cm between opposite knots) during rainy and dry season between 2010 and 2012. We captured 1,626 specimens belonging to three orders, nine families and 17 species, six of which are endemic to the Caatinga. Approximately 30% of the species observed were non-native and had been introduced for stocking purposes.

INTRODUCTION

According to recent estimates, there are approximately 28,000 fish species in the world (Nelson 2006), 2,500 of which have been confirmed for Brazilian freshwater systems (Reis *et al*. 2003; Buckup *et al*. 2007). However, these results may be underestimated due to the scarcity of extensive taxonomic surveys and the vast geographical areas involved (Rosa *et al*. 2003; Abell *et al*. 2008; Lévêque *et al*. 2008). Rodolpho von Ihering, a Brazilian zoologist of German descent, was the first to conduct a survey of the ichthyofauna of Ceará. He registered nearly 70 species from the rivers Jaguaribe, Salgado, Choró and Cocó in the first half of the 20th century (Fowler 1941). A recent compilation listed 240 species for the Caatinga, 83 of which in the mideastern part of the Northeastern ecoregion (Rosa *et al*. 2003). According to Rosa and Lima (2008), 135 species of Brazilian freshwater fishes are currently endangered, of which 13 species occur in the Northeastern Brazilian region, inserted in the São Francisco Basin and Eastern Basins ecoregions. The apparent scarcity of endangered species among the Northeastern fish fauna is more likely explained by the lack of information than by proper conservation and management (Rosa *et al*. 2003).

In fact, the native fish diversity in semiarid Northeastern Brazil has been seriously reduced by habitat destruction, by the introduction of exotic species, and by the elimination of some native species (such as piranhas) by piscicides (Gurgel and Costa 1994; Silva and Araújo 1996; Rosa *et al*. 2003; Langeani *et al*. 2009). In addition, artificial eutrophication caused by agricultural discharge and human wastewater (Figueirêdo *et al*. 2006) from neighboring municipalities with poor sanitary conditions (Santana 2009) has had a considerable impact on fish assemblages, changing the faunal composition and thereby the population dynamics of less tolerant species (Smith *et al*. 1999; Esteves and Meirelles-Pereira 2011).

The purpose of this study was to survey the ichthyofauna of two major reservoirs in the middle Acaraú river basin as a subsidy for future studies and for the management of the region's fishing resources.

MATERIALS AND METHODS

Study site

The survey covered two important reservoirs in the mideastern part of the Northeastern ecoregion, the Paulo Sarasate reservoir (PS) and, 50 km away, the Edson Queiroz reservoir (EQ), which impound the waters of the Acaraú river and of the Groaíras river, respectively (Figure 1). The Acaraú river basin covers an area of 14,427 km^2, with 298 km of artificially perennialized streams (Pinheiro *et al*. 2006). PS is larger than EQ and was built in 1958 in order to perennialize the Acaraú river, control seasonal floods, generate electric power and provide water for irrigation, fish farming and household consumption. It has a storage capacity of 891 million m^3, a surface area of 96.2 km^2, a hydrographic basin covering 3,517 km^2 (SRH 2010) and accounts for over 60% of the water volume of the Acaraú river basin (Santana 2009). EQ was built in 1987 in the most arid part of the Acaraú river basin. It has a storage capacity of 254 million m^3, a surface area of 26.6 km^2, and a hydrographic basin of 1,765 km^2 (SRH 2010). It plays an important social and economic role in irrigation, water supply and flood prevention (Zanella 2005). Both reservoirs are considered eutrophic (Figueirêdo *et al*. 2006).

Data Collection

Four fish samplings were carried out in the rainy season (January 2011 and March 2012, in both PS and EQ) and four in the dry season (PS: July 2010 and October 2011; EQ: July 2010 and August 2011). The coordinates of the sampling points were 04°14'03" S, 40°27'40" W in PS, and

04°13'27" S, 40°02'08" W in EQ. The sampling locations were in the limnetic middle zone of the reservoirs, at a depth of four to seven meters (Figure 1). Nineteen floating gillnets were deployed (from the surface to a depth of 2 m) in nycthemeral cycles, with collection at six-hour intervals. The mesh size varied between 3 and 12 cm between the opposing knots, with sections mounted in random order. The fish were captured under license #23837-1 from the Ministério do Meio Ambiente (MMA) and the Instituto Chico Mendes de Conservação da Biodiversidade (ICMBio).

The collected specimens were cryoanesthetized in an ice box, fixed on-site in 10% formaldehyde and transported to the Laboratory of Aquatic Ecology of the Federal University of Ceará. The taxonomic identification was based on Britski *et al*. (1984; 2007), Castro and Vari (2004), Kullander (1983), Kullander and Ferreira (2006), Malabarba (2004), Oyakawa and Mattox (2009), Ploeg (1991), Silva (2009), and Vari (1989; 1991). The species *Hypostomus jaguribensis* was identified with the assistance of Dr. Pedro Hollanda Carvalho. All specimens were deposited in the fish collection of the Federal University of Rio Grande do Norte (UFRN), Rio Grande do Norte state, Brazil.

Results and Discussion

A total of 1,626 specimens were collected from the two reservoirs, representing 17 species, 14 genera, nine families and three orders of fish (Table 1). Seven of these species are considered endemic to the Caatinga: *Cichlasoma orientale*, *Hypostomus jaguribensis*, *Leporinus* cf. *piau*, *Prochilodus brevis*, *Psectrogaster rhomboides*, *Steindachnerina* cf. *notonota* and *Triportheus signatus*

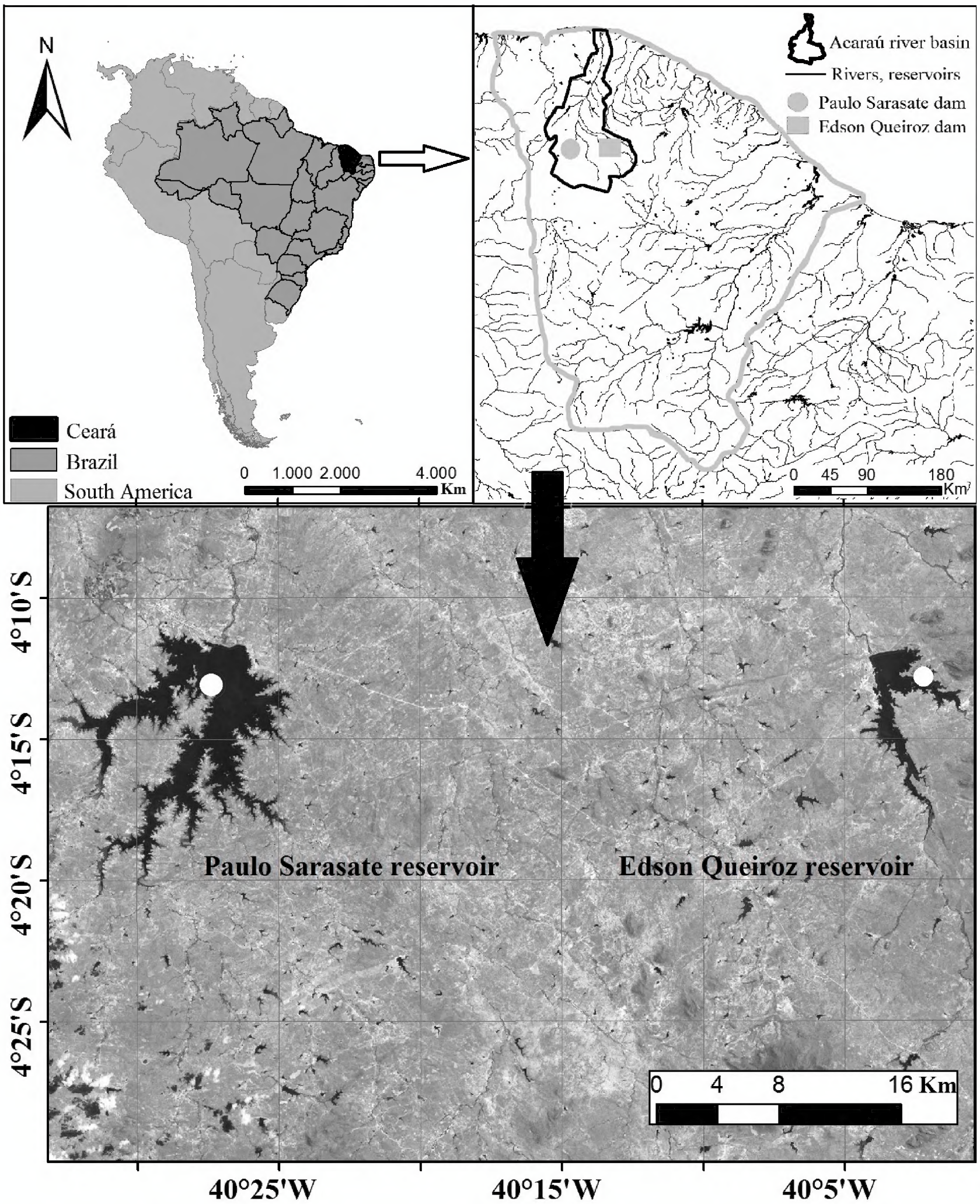

Figure 1. Location of the Paulo Sarasate reservoir (PS) and the Edson Queiroz reservoir (EQ) in the Acaraú river basin (state of Ceará, Brazil). The white points indicate fish sampling locations.

(Rosa *et al.* 2003). Seven fish species (*Astyanax* gr. *bimaculatus*, *Astyanax* gr. *fasciatus*, *Crenicichla menezesi*, *Hoplias brasiliensis*, *Hoplias malabaricus*, *Leporinus* sp., and *Trachelyopterus galeatus*) are native to the Caatinga, however, occurs in other regions of the Brazil. Three are introduced: *Plagioscion squamosissimus* is native from the Maranhão-Piauí ecoregion, *Cichla monoculus* is native from the Amazon basin, and *Oreochromis niloticus* has an African origin.

The order most represented was Characiformes (58.8% of the species), followed by Perciformes (29.5%), and Siluriformes (11.7%). When the exotic species were excluded, the orders Perciformes and Siluriformes contributed equally to the assemblage's richness (14.3% each). The families with most species sampled were Cichlidae (23.5%) and Characidae (17.6%); or, when the exotic species were excluded, Characidae (21.4%). According to Lévêque *et al.* (2008), a significant evolutionary radiation occurred in the Neotropics following the end of the Cretacean involving the orders Characiformes and Siluriformes, the two most species-rich fish orders for this region.

The species collected in the present study make up only 20% of the species listed by Rosa *et al.* (2003) for the mideastern part of the Northeastern ecoregion, and only 27% of the genera registered by Rodolpho von Ihering for rivers in Ceará (Fowler 1941). The relatively small fish diversity observed in our study is probably the result of the type of gear employed (gillnets) in a single habitat, the limnetic zone of the reservoirs (Medeiros *et al.* 2010). The use of other fishing methods, such as cast nets or seine nets, might have resulted in the capture of additional species, including *Poecilia vivipara*, which has previously been observed during field work in local coastal freshwater systems (Sánchez-Botero, personal observation); and *Synbranchus marmoratus*, a native species registered by Batista in 2011 (unpublished data) based on interviews with local subsistence fishermen.

Studies in the Brazilian semiarid reservoirs using the same fishing methodology (gillnets) had eleven and seven species for Taperoá II and Riacho da Cruz reservoirs, respectively (Teixeira and Gurgel 2005; Montenegro *et al.* 2012). Thus, when their richness were compared with those obtained in the reservoirs PS and EQ, we observed that the latter had higher species richness of fish possibly influenced by the size and the position of the reservoir in its basin, age of the ecosystem and anthropogenic impacts. Thus, the composition of the ichthyic assemblage is a particular characteristic of each reservoir and indicative of its state of conservation.

Based on fish fry stocking reports of the *Departamento Nacional de Obras Contra as Secas* (DNOCS), the list of ichthyofauna artificially introduced into PS and EQ includes the exotic species *Cyprinus carpio* and *O. niloticus*, and the non-native species *Piaractus brachypomus* and *Colossoma macropomum* (Table 2). In addition, in 2011 Batista (unpublished data) reported another exotic species (*Tilapia rendalli*) in the same reservoirs based on interviews with local subsistence fishermen. When these species are considered, the percentage of species introduced in the middle Acaraú river basin increases to 30.4%. Allochthonous species may be found permanently in PS and EQ due to legal fish fry stocking by DNOCS since the 1970s.

In addition to the large number of endemic species (41.2% of the collected species and 30.4% of the registered species), confirming the claim of Rosa *et al.* (2003) regarding the high level of endemism in the Caatinga, nine native (non-endemic) species were collected in the present survey, totaling 16 regional species. Five of these are medium or large-size (*H. brasiliensis*, *H. malabaricus*, *P. brevis*, *Leporinus* sp. and *L.* cf. *piau*) and constitute an important food source for the local communities. Alien species also comprise important food and economic source, especially *O. niloticus*, a fish well adapted to local environmental conditions, but that brings harm to the indigenous fish fauna as evidenced by Attayde *et al.* (2011).

The most abundant species observed in the study were *T. signatus* (n=1,015), *P. squamosissimus* (n=245), and *Astyanax* gr. *fasciatus* (n=61). The first and the last are small fishes with little or no economic value. Their higher abundance may be explained by lesser fishing pressure. Moreover, according to Agostinho *et al.* (1999), small species tend to be more successful in reservoir ecosystems due to the large supply of resources and characteristics of life history (*e.g.*, *fast growth, reproductive compensation*). On the other hand, the type of gear employed (gillnets) is more selective for larger species (Medeiros *et al.* 2010). The abundance of the allochthonous species *P. squamosissimus*, which has not been restocked in the past nine years (Table 2), may be explained by the fact that artificial reservoirs are prone to domination by non-native species because they favor the emergence of niches not found in natural pristine environments which may be occupied by introduced species (Havel *et al.* 2005).

In conclusion, the present survey provides taxonomic information and subsidies for the monitoring of the fish fauna and management of fishing resources in the middle Acaraú river basin, an economically important region in the state of Ceará, Northeastern Brazil.

Table 1. List of fish species in the Paulo Sarasate (PS) and Edson Queiroz (EQ) reservoirs, middle Acaraú river basin, Ceará, Brazil. Taxonomic positions are consistent with Reis *et al.* (2003).

TAXON	FOLK NAME	ORIGIN	PS	EQ	VOUCHER NUMBER
CHARACIFORMES					
Curimatidae					
Psectrogaster rhomboides Eigenmann and Eigenmann, 1889	"branquinha"	endemic*	X	X	UFRN 903 to UFRN 905
Steindachnerina cf. *notonota* (Miranda Ribeiro,1937)	"piabaçu"	endemic*		X	UFRN 902
Prochilodontidae					
Prochilodus brevis Steindachner, 1875	"curimatã"	endemic*, **	X	X	UFRN 895 to UFRN 896
Anostomidae					
Leporinus sp. Spix and Agassiz, 1829	"piau"	native	X	X	UFRN 925 to UFRN 927
Leporinus cf. *piau* Fowler, 1941	"piau-verdadeiro"	endemic*	X	X	UFRN 920 to UFRN 924
Characidae					
Astyanax gr. *bimaculatus* (Linnaeus, 1758)	"piaba"	native		X	UFRN 897
Astyanax gr. *fasciatus* (Cuvier, 1819)	"piaba"	native	X	X	UFRN 898 to UFRN 901
Triportheus signatus (Garman, 1890)	"sardinha"	endemic*	X	X	UFRN 906 to UFRN 907
Erythrinidae					
Hoplias brasiliensis (Spix and Agassiz, 1829)	"traíra"	native	X		UFRN 930
Hoplias malabaricus (Bloch, 1794)	"traíra"	native	X	X	UFRN 931 to UFRN 933
SILURIFORMES					
Loricariidae					
Hypostomus jaguribensis (Fowler, 1915)	"bodó", "cascudo"	endemic*	X	X	UFRN 891 to UFRN 894
Auchenipteridae					
Trachelyopterus galeatus (Linnaeus, 1766)	"cangati"	native	X		UFRN 909
PERCIFORMES					
Sciaenidae					
Plagioscion squamosissimus (Heckel, 1840)	"pescada-do-Piauí"	non-native	X	X	UFRN 928 to UFRN 929
Cichlidae					
Cichla monoculus Spix and Agassiz, 1831	"tucunaré"	non-native	X	X	UFRN 912 to UFRN 917
Cichlasoma orientale Kullander, 1983	"cará-preto"	endemic*	X		UFRN 918 to UFRN 919
Crenicichla menezesi Ploeg, 1991	"jacundá"	native	X	X	UFRN 910 to UFRN 911
Oreochromis niloticus (Linnaeus, 1758)	"tilapia-do-Nilo"	exotic**	X	X	UFRN 908

X: occurrence; *species endemic to the Caatinga (Rosa et al. 2003); **species stocked by DNOCS.

Table 2. Amount in units of fish fry stocked by DNOCS in the Paulo Sarasate and Edson Queiroz reservoirs, middle Acaraú river basin, from 2003 to 2011.

		Units of fish fry stocked				
Reservoir	**Year**	***O. niloticus* (exotic)**	***C. carpio* (exotic)**	***C. macropomum* (non-native)**	***P. brachypomus* (non-native)**	***P. brevis***
Paulo Sarasate	2003	369,300	11,450	1,700	5,700	-
	2004	367,500	-	-	-	-
	2005	586,250	-	-	-	-
	2006	595,150	1,000	-	-	-
	2007	558,000	-	-	-	-
	2008	809,050	6,000	200	-	-
	2009	752,000	700	-	-	-
	2010	240,000	-	-	-	-
	2011	232,000	-	500	-	-
Edson Queiroz	2003	112,000	1,500	1,000	-	-
	2004	223,500	5,700	-	200	-
	2005	487,400	1,500	100	-	-
	2006	421,780	1,000	-	-	-
	2007	547,000	6,000	-	-	-
	2008	471,000	3,500	300	-	-
	2009	450,000	5,000	-	-	100
	2010	370,000	-	-	-	-
	2011	130,000	-	500	-	-

Source: DNOCS.

Acknowledgments: This study was part of a project funded by FUNCAP [Fundação Cearense de Apoio ao Desenvolvimento Científico e Tecnológico], CNPq [Conselho Nacional de Desenvolvimento Científico e Tecnológico], FCPC [Fundação Cearense de Pesquisa e Cultura], through the PPP [Programa Primeiros Projetos], according to agreement GPF#2153/85. In addition, we would like to thank PIBIC [Programa Institucional de Bolsas de Iniciação Científica] for financial support and COGERH [Companhia de Gestão dos Recursos Hídricos], especially Walt Disney Paulino, Francymeire Avelino and Edmundo Rodrigues, for logistic support. Last but not least, our thanks to the team at the Laboratory of Aquatic Ecology of the Federal University of Ceará for their assistance with the field work.

Literature Cited

Abell, R., M.L. Thieme, C. Revenga, M. Bryer, M. Kottelat, N. Bogutskaya, B. Coad, N. Mandrak, S. Contreras-Balderas, W. Bussing, M.L.J. Stiassny, P. Skelton, G.R. Allen, P. Unmack, A. Naseka, R. Ng, N. Sindorf, J. Robertson, E. Armijo, J.V. Higgins, T.J. Heibel, E. Wikramanayake, D. Olson, H.L. López, R.E. Reis, J.G. Lundberg, M.H. Sabaj-Pérez and P. Petry. 2008. Freshwater Ecoregions of the World: a new map of biogeographic units for freshwater biodiversity conservation. *BioScience* 58(5): 403-414.

Agostinho, A.A., L.E. Miranda, L.M. Bini, L.C. Gomes, S.M. Thomaz and H.I. Suzuki. 1999. Patterns of colonization in Neotropical reservoirs, and prognoses on aging; p. 227-265 *In* J.G. Tundisi and M.S Straskraba (ed.). *Theoretical reservoir ecology and its application*. São Carlos: IIE.

Attayde, J.L., J. Brasil and R.A. Menescal. 2011. Impacts of introducing Nile tilapia on the fisheries of a tropical reservoir in North-eastern Brazil. *Fisheries Management and Ecology* 18(6): 437-443.

Britski, H.A., Y. Sato and A.B.S. Rosa. 1984. *Manual de identificação de peixes da região de Três Marias: com chave de identificação para os peixes da bacia do São Francisco*. Brasília: Câmara dos Deputados, Coordenação de Publicações – CODEVASF, Divisão de Piscicultura e Pesca. 143 p.

Britski, H.A., K.Z.S. Silimon and B.S. Lopes. 2007. *Peixes do Pantanal: manual de identificação*. Brasília: Embrapa Informação Tecnológica. 227 p.

Buckup, P.A., Menezes, N.A. and M.S. Ghazzi. 2007. *Catálogo das espécies de peixes de água doce do Brasil*. Rio de Janeiro: Museu Nacional. 195 p.

Castro, R.M.C. and R.P. Vari. 2004. Detritivores of the South American fish family Prochilodontidae (Teleostei: Ostariophysi: Characiformes): A phylogenetic and revisionary study. *Smithsonian Contributions to Zoology* (622): 190 p.

Esteves, F.A. and F. Meirelles-Pereira. 2011. Eutrofização artificial; p. 625-655. *In* F.A Esteves (coord.). *Fundamentos de Limnologia*. Rio de Janeiro: Interciência.

Figueirêdo, M.C.B., V.P.P.B. Vieira and F.S.B. Mota. 2006. Avaliação do risco de eutrofização em reservatórios da bacia do Acaraú, Ceará, Brasil. *Revista Tecnologia* 27(2): 179-189.

Fowler, H.W. 1941. A collection of fresh-water fishes obtained in eastern Brazil by Dr. Rodolpho von Ihering. *Academy of Natural Sciences Philadelphia* 93: 123-199.

Gurgel, J.J.S. and R.S. Costa. 1994. Sobre a produtividade da pesca em 16 açudes públicos da bacia hidrográfica do rio Jaguaribe, Ceará, Brasil. *Caatinga* 8(1/2): 58-67.

Havel, J.E., C.E. Lee and M.J. Vander Zanden. 2005. Do reservoirs facilitate invasions into landscapes? *BioScience* 55(6): 518-525.

Kullander, S.O. 1983. *A revision of the South American cichlid genus Cichlasoma (Teleostei: Cichlidae)*. Stockholm: Naturhistoriska Riksmuseet. 296 p.

Kullander, S.O. and E.J.G. Ferreira. 2006. A Review of the South American cichlid genus *Cichla*, with descriptions of nine new species (Teleostei: Cichlidae). *Ichthyological Exploration of Freshwaters* 17(4): 289-398.

Langeani, F., P.A. Buckup, R.L. Malabarba, L.H.R. Py-Daniel, C.A.S. Lucena, R.S. Rosa, J.A.S. Zuanon, Z.M.S. Lucena, M.R. Britto, O.T. Oyakawa and G. Gomes-Filho. 2009. Peixes de água doce; p. 211-230 *In* R.M. Rocha and W.A. Boeger (ed.). *Estado da arte e perspectivas para a Zoologia no Brasil*. Curitiba: Editora UFPR.

Lévêque, C., T. Oberdorff, D. Paugy, M.L.J. Stiassny and P.A. Tedesco. 2008. Global diversity of fish (Pisces) in freshwater. *Hydrobiologia* 595: 545-567.

Malabarba, M.C.S.L. 2004. Revision of the Neotropical genus *Triportheus* Cope, 1872 (Characiformes: Characidae). *Neotropical Ichthyology* 2(4): 167-204.

Medeiros, E.S.F., M.J. Silva, B.R.S. Figueiredo, T.P.A. Ramos and R.T.C. Ramos. 2010. Effects of fishing technique on assessing species composition in aquatic systems in semi-arid Brazil. *Brazilian Journal of Biology* 70(2): 255-262.

Montenegro, A.K.A., J.E.R. Torelli, M.C. Crispim, M.I.M. Hernández and A.M.A. Medeiros. 2012. Ichthyofauna diversity of Taperoá II reservoir, semi-arid region of Paraíba, Brazil. *Brazilian Journal of Biology* 72(1): 113-120.

Nelson, J.S. 2006. *Fishes of the world*. Hoboken: John Wiley & Sons. 621 p.

Oyakawa, O.T. and G.M.T. Mattox. 2009. Revision of the Neotropical trahiras of the *Hoplias lacerdae* species-group (Ostariophysi: Characiformes: Erythrinidae) with descriptions of two new species. *Neotropical Ichthyology* 7(2): 117-140.

Pinheiro, L.S., M.F. Rosa and P.A.P. Sucupira. 2006. O contexto ambiental e socioeconômico do médio e baixo curso do rio Acaraú, Ceará: implicações para a gestão dos recursos hídricos; p. 125-146 *In* D.R.C. Pinheiro (ed.). *Desenvolvimento sustentável: desafios e discussões*. Fortaleza: ABC Editora.

Ploeg, A. 1991. *Revision of the South American cichlid genus Crenicichla Heckel, 1840 with descriptions of fifteen new species and considerations on species groups, phylogeny and biogeography (Pisces, Perciformes, Cichlidae)*. Amsterdam: Akademisch Proefschrift, Universiteit van Amsterdam. 153 p.

Reis, R.E., S.O. Kullander and C.J. Ferraris Jr. 2003. *Check list of the freshwater fishes of South and Central America*. Porto Alegre: EDIPUCRS. 742 p.

Rosa, R.S. and F.C.T. Lima. 2008. Os peixes brasileiros ameaçados de extinção; p. 9-285 *In* A.B.M. Machado, G.M. Drummond and A.P. Paglia (ed.). *Livro vermelho da fauna brasileira ameaçada de extinção*. Brasília: MMA.

Rosa, R.S., N.A. Menezes, H.A. Britski, W.J.E. Costa and F. Groth. 2003. Diversidade, padrões de distribuição e conservação dos peixes da caatinga; p. 135-180 *In* I.R. Leal, M. Tabarelli and J.M.C. Da Silva (ed.). *Ecologia e Conservação da Caatinga*. Recife: Editora Universitária da Universidade Federal de Pernambuco.

Santana, E.W. 2009. *Caderno regional da bacia do Acaraú*. Conselho de Altos Estudos e Assuntos Estratégicos, Assembleia Legislativa do Estado do Ceará. Fortaleza: INESP. 128 p.

Silva, J.W.B. 2009. *Tilápias: Biologia e Cultivo – evolução, situação atual e perspectivas da tilapicultura no Nordeste brasileiro*. Fortaleza: Edições UFC. 326 p.

Silva, J.W.B. and F.A.G. Araújo. 1996. Resultados do povoamento de dez açudes públicos do Ceará, Brasil, com espécies selecionadas de peixes. *Revista Ciência Agronômica* 27(1/2): 23-28.

Smith, V.H., G.D. Tilman and J.C. Nekola. 1999. Eutrophication: impacts of excess nutrient inputs on freshwater, marine, and terrestrial ecosystems. *Environmental Pollution* 100: 179-196.

SRH - Secretaria dos Recursos Hídricos 2010. Atlas Eletrônico dos Recursos Hídricos do Ceará. Electronic Database accessible at http://atlas.srh.ce.gov.br/. Captured on 8 April 2012.

Teixeira, J.L.A. and H.C.B. Gurgel. 2005. Ocorrência e distribuição temporal da ictiofauna do açude Riacho da Cruz, no Rio Grande do Norte. *Revista Ceres* 52(300): 317-324.

Vari, R.P. 1989. Systematics of the Neotropical Characiform genus *Psectrogaster* Eigenmann and Eigenmann (Pisces: Characiformes). *Smithsonian Contributions to Zoology* (481): 52 p.

Vari, R.P. 1991. Systematics of the Neotropical Characiform genus *Steindachnerina* Fowler (Pisces: Ostariophysi). *Smithsonian Contributions to Zoology* (507): 128 p.

Zanella, M.E. 2005. As características climáticas e os recursos hídricos do Estado do Ceará; p. 169-188. *In* J. Borzacchiello, T. Cavalcante and E. Dantas. (ed.). *Ceará: um novo olhar geográfico*. Fortaleza: Edições Demócrito Rocha.

Received: February 2013
Accepted: July 2013
Published online: November 2013
Editorial responsibility: Pedro Hollanda Carvalho